



Internally Replicating SAP Systems on the Hitachi Adaptable Modular Storage 2000 Family

Implementation Guide

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Summary

Most SAP customers rely on their IT environments to be available 24 hours a day, seven days a week. They cannot tolerate any process that might have a negative effect on the production instance's performance or availability. Given the critical nature of SAP deployments, it is important to have a secondary copy of the production landscape's data available for a variety of processes. One of the most powerful capabilities within an advanced storage infrastructure is the ability to create multiple copies of data with no impact on the production instance. Although this capability is extremely powerful, it can also be one of the most complex of the storage administration tasks.

The solution described in this white paper uses Hitachi Adaptable Modular Storage 2000 family storage systems and Hitachi ShadowImage® Heterogeneous Replication software to replicate an SAP Production ERP instance and prepare the copy for access by a secondary server. It provides step-by-step instructions for preparing the environment for replication, configuring replication and implementing replication for off-host processing.

For best results use Acrobat Reader 8.0.



Contributors

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Most SAP customers rely on their IT environments to be available 24 hours a day, seven days a week. They cannot tolerate any process that might have a negative effect on the production instance's performance or availability. Given the critical nature of SAP deployments, it is important to have a secondary copy of the production landscape's data available for a variety of processes.

One of the most powerful capabilities within an advanced storage infrastructure is the ability to create multiple copies of data with no impact on the production instance. These copies are used for a variety of purposes: backup, data mining, test environments and so on. Although this capability is extremely powerful, it can also be one of the most complex of the storage administration tasks. Introducing any process into a production SAP environment requires detailed planning and testing to ensure that the process does not impact production and can be documented and repeated.

The solution described in this white paper uses Hitachi Adaptable Modular Storage 2000 family storage systems and Hitachi ShadowImage[®] Heterogeneous Replication software to replicate an SAP Production ERP instance and prepare the copy for access by a secondary server. It provides step-by-step instructions for preparing the environment for replication, configuring replication and implementing replication for off-host processing

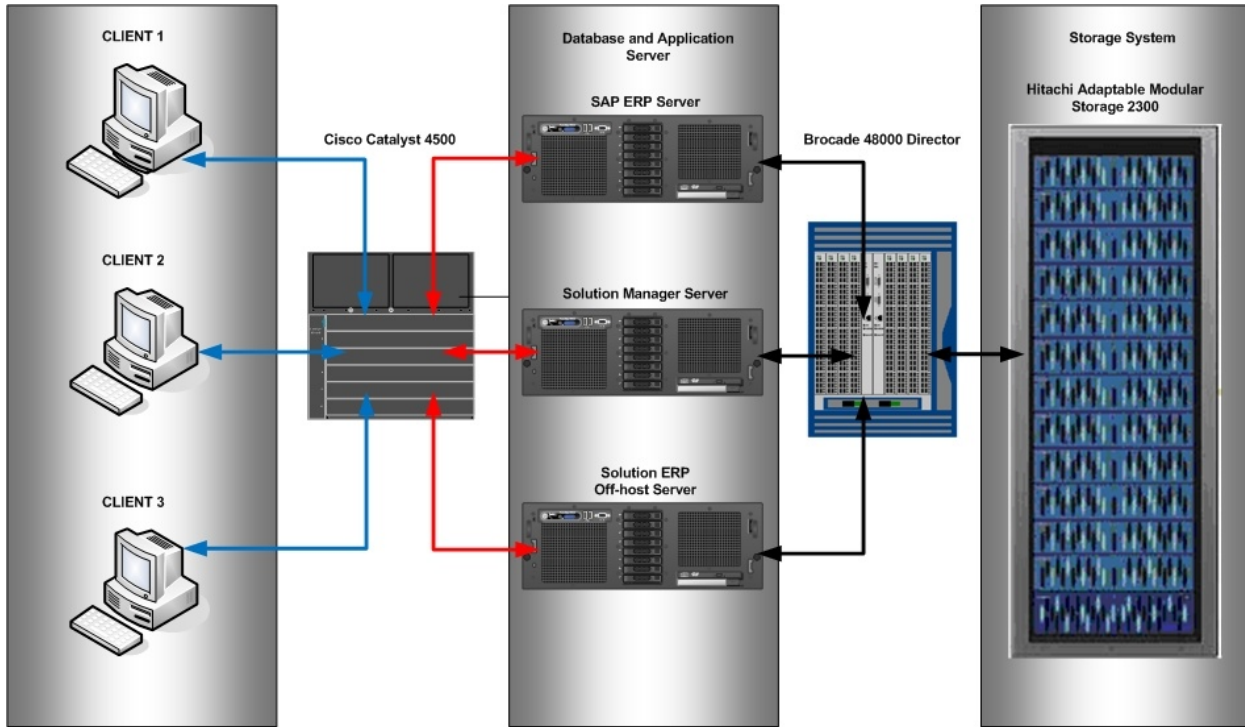
This white paper is written for IT professionals who are charged with storage or SAP planning, deployment or administration. It assumes basic knowledge of SAN concepts and operating practices. It provides prescriptive guidance that assists those individuals in configuring and managing the replication process in an SAP environment.

Although the laboratory testing performed for this white paper used the Hitachi Adaptable Modular Storage 2300, any member of the 2000 family is appropriate for this solution.

Solution Components

This white paper describes a solution that includes an SAP client that accesses the SAP application infrastructure for on-host as well as off-host processing, which in turn stores data in and accesses data from a Hitachi Adaptable Modular Storage 2000 family storage system, as illustrated by Figure 1.

Figure 1. Solution Architecture



In the tested deployment, the client tier consists of Windows-based servers with SAP GUI installed. The clients connect to the SAP systems in the application tier via a Cisco Catalyst 4500 switch. The SAP Solution Manager is installed on a management server. The SAP application tier and database tier for on-host as well as off-host processing are installed on individual servers. The SAP application is connected to a Hitachi Adaptable Modular 2300 storage system via a Brocade 48000 director.

Tested Deployment

The following sections describe the hardware and software used to deploy the solution described in this white paper.

Table 1 describes the hardware used in the tested deployment.

Table 1. Tested Deployment Hardware

<i>Hardware</i>	<i>Quantity</i>	<i>Configuration</i>	<i>Role</i>
Hitachi Adaptable Modular Storage 2300 storage system	1	Microcode 0870/C-M* 2 storage controllers 4 disk trays (RKA) 40 x 146GB 15K RPM SAS drive 8GB cache per controller	N/A
Brocade 48000 SAN Fibre Channel switch	1	FOS 6.21* 10 4Gb Fibre Channel ports used	N/A
Dell Power Edge R905 server	1	4 quad core AMD Opteron 1.9GHz Processors 64GB memory. 2 Emulex LPe11002-MH4 Fibre Channel Host bus adapters (HBAs) 4Gb/s	SAP Solution Manager server
Dell Power Edge R905 server	1	4 quad core AMD Opteron 1.9GHz Processors 64GB memory. 2 Emulex LPe11002-MH4 Fibre Channel HBAs 4Gb/s	SAP ERP server
Dell Power Edge R905 server	1	4 quad core AMD Opteron 1.9GHz Processors 64GB memory. 2 Emulex LPe11002-MH4 Fibre Channel HBAs 4Gb/s	SAP ERP off-host server
Dell PowerEdge 750	2	Intel Pentium 3.0GHz processor 1GB memory	SAP clients
Dell PowerEdge 750	1	Intel Pentium 3.0GHz processor 1GB memory	Management server with Hitachi Storage Navigator Modular 2 software

Table 2 lists the software used in the tested deployment.

Table 2. Tested Deployment Software

Software	Version
SAP ERP	6.0 Special Release 3 (SR3)
SAP Solution Manager	7.0
SAP GUI	7.1
Oracle Database 10g Enterprise Edition	10.2.0.4
Hitachi Storage Navigator Modular 2	7.21
Hitachi Command Control Interface (CCI)	01-23
Hitachi Dynamic Link Manager	6.0.1.0.804
Hitachi ShadowImage Heterogeneous Replication	Available with Hitachi Adaptable Modular Storage 2300

The following sections provide information about each of the components of the tested deployment.

Hitachi Adaptable Modular 2000 Family

The Hitachi Adaptable Modular Storage 2000 family provides a reliable, flexible, scalable and cost effective modular storage system for the solution described in this white paper. The 2000 family is ideal for demanding application requirements and delivers enterprise class performance, availability, capacity and functionality at a midrange price.

The 2000 family is the only midrange storage product with symmetric active-active controllers that provide integrated, automated hardware-based front-to-back-end I/O load balancing. Both controllers in a 2000 family storage system are able to dynamically and automatically assign the access paths from the back of the controller to the LU. All LUs are accessible regardless of the physical port or the server from which the access is requested. Utilization rates of each controller are monitored so that a more even distribution of workload between the two controllers can be maintained.

The 2000 family also provides a high performance and reliable volume replication function that can generate point-in-time copies quickly using Hitachi ShadowImage[®] Heterogeneous Replication software.

No other midrange storage product that scales beyond 100TB has a serial attached SCSI (SAS) drive interface. The point-to-point back-end design virtually eliminates I/O transfer delays and contention associated with Fibre Channel arbitration and provides significantly higher bandwidth and I/O concurrency. It also isolates any component failures that might occur on back-end I/O paths.

Although Hitachi Data Systems testing for this solution used the Hitachi Adaptable Modular Storage 2300, any member of the 2000 family can be used to deploy this solution

Servers

Servers must meet specification requirements for the SAP Solution Manager and SAP ERP roles they are hosting. For more information about server requirements for SAP ERP, SAP Solution Manager and SAP clients, see the following SAP Notes, which are available to licensed customers from SAP's [Web site](#):

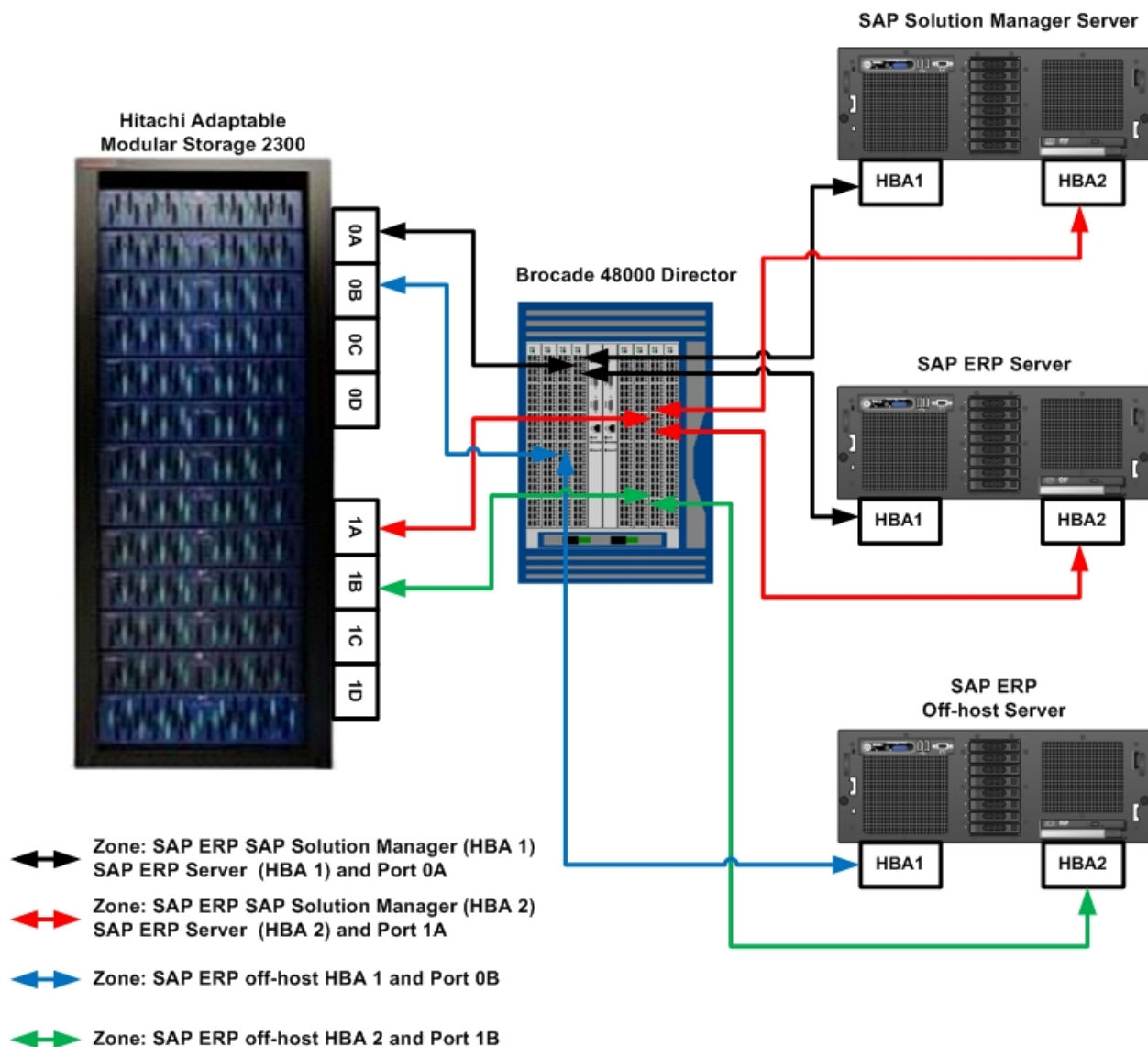
- SAP Note 1094599, *Installation NW7-SR3/Business Suite 2005 SR3 Unix/Oracle*
- SAP Note 26147, *SAP GUI Resources: Hardware and Software*
- SAP Note 901070, *Resource Requirements for SAPECC6*

Storage Area Network Components

Attach the SAP ERP server, SAP ERP off-host server and SAP Solution Manager Server to redundant HBAs via a SAN consisting of a Fibre Channel switch or a director. The Hitachi Adaptable Modular Storage 2300, which was used in testing for this solution, has eight Fibre Channel ports, four ports on each controller. In the tested deployment, the SAP ERP and SAP Solution Manager servers were connected via two HBAs each to a Brocade 48000 Director. The Brocade 48000 director, in turn, was connected to two different ports of the Hitachi Adaptable Modular Storage 2300. The SAP ERP off-host server was connected to two HBAs to the same Brocade 48000 director. However, the Brocade 48000 director connections for the SAP ERP off-host server were connected to two different ports on the Hitachi Adaptable Modular Storage 2300.

Figure 2 illustrates the redundant paths that are managed by Hitachi Dynamic Link Manager Advanced software in the deployment tested for this solution.

Figure 2. Connections to the Hitachi Adaptable Modular Storage 2300



SAP Software

SAP provides business software and enterprise applications that enable companies to execute their business and IT strategies more effectively by integrating structured and unstructured information, business processes and people involved. SAP is based on a NetWeaver technology platform that allows an enterprise to choose from a wide variety of operating systems and database management systems. An SAP system can be flexibly deployed either in a single-stack (using ABAP) or dual-stack (using ABAP and Java) environment. In addition, due to its three-tier architecture, SAP systems can scale vertically and horizontally.

SAP ERP

SAP ERP combines scalable and effective software for enterprise resource planning (ERP) with a flexible, open technology platform that can leverage and integrate SAP and non-SAP systems. This industry leading solution provides end-to-end software functionality for enterprise management and support by controlling and processing business related company processes. The tested deployment described in this white paper uses ERP version 6.0 Special Release 3 (SR3).

SAP Solution Manager

SAP Solution Manager is a service and support platform that provides the integrated content, tools and methodologies to implement, support and monitor operations of SAP implementations. Solution Manager is installed on a separate system. The tested deployment described in this white paper used SAP Solution Manager Version 7.0.

SAP GUI 7.1

SAP GUI is the client software that allows SAP users to access various functionalities in SAP applications and SAP Solution Manager. The tested deployment described in this white paper used SAP GUI version 7.1 on various clients.

Oracle Database 10.2.0.4

SAP systems can be used with a variety of databases available from different vendors. The execution of business transactions in SAP systems are processing units grouped to provide specific functions; these processing units execute changes to the database that are consistent. Oracle is the industry leader in providing state-of-the-art high performance database management system. Oracle has several technological features embedded in the database software that provide flexibility and manageability. Some of these features cover backup and recovery, cloning of database etc. The tested deployment described in this white paper uses the Oracle database version 10.2.0.4 that is available from SAP.

SAP BRBackup

SAP BRBackup is a backup and recovery tool specifically for Oracle databases. The flexibility of SAP BRBackup allows users to take variety of backups such as online backups, offline backups, tape backups, split mirror backup etc.

Hitachi Software

Hitachi software helps you maintain high levels of information availability and optimize application performance while improving IT staff productivity through the automation of management and maintenance tasks.

Hitachi ShadowImage In-System Replication Software

Hitachi ShadowImage In-system replication software (ShadowImage) is a storage-based hardware solution that creates RAID-protected duplicate volumes within the Hitachi Adaptable Modular 2000 family. ShadowImage primary volumes (P-VOLs) contain the original data and up to nine secondary volumes (S-VOLs) can be created as copies.

ShadowImage operation are non disruptive and allow the primary volumes to remain online to all hosts for read and write I/O operations.

The functions of ShadowImage are made available through Hitachi Storage Navigator Modular 2 graphical interface (GUI), Hitachi Storage Navigator Modular 2 command-line interface (CLI) OR Hitachi Command Control Interface (CCI).

Hitachi Command Control Interface (CCI)

Hitachi Command Control Interface is software that allows users to configure, control and manage data replication operations by issuing commands from the open-system host. CCI is also called RAID Manager.

Install Hitachi Command Control Interface (CCI) on the SAP ERP server as well as the SAP ERP off-host server to manage data replication between them.

Hitachi Storage Navigator Modular 2 Software

Hitachi Storage Navigator Modular 2 software is part of the Hitachi Basic Operating System software package. It monitors and manages Hitachi modular storage systems, including the Hitachi Adaptable Modular Storage 2000 family, through either a GUI or a command-line interface (CLI). Use Storage Navigator Modular 2 software to create RAID groups and LUs and to assign those LUs to SAP Solution Manager and SAP ERP servers.

Hitachi Dynamic Link Manager Advanced Software

Hitachi Dynamic Link Manager Advanced software bundles Hitachi Dynamic Link Manager I/O multipathing software and Hitachi Global Link Manager software. Hitachi Dynamic Link Manager Software, which is installed on the SAP ERP, the SAP ERP off-host server and the SAP Solution Manager servers, includes capabilities such as path failover and failback and automatic load balancing to provide higher data availability and accessibility.

Install Hitachi Dynamic Link Manager Advanced software on the SAP ERP server, SAP ERP off-host server and the SAP Solution Manager server.

Deploying the Solution

This solution assumes that the SAP ERP server and the SAP Solution Manager server are already installed and configured. Deploying this solution also requires deploying an SAP ERP off-host server by following these high-level steps:

1. Configure storage and storage network for SAP ERP off-host server.
2. Install and configure SAP ERP on off-host server.
3. Enable the infrastructure for ShadowImage software.
4. Configure replication using CCI.
5. Implement replication for off-host processing.

Your checklist might vary based on your environment. More details about each of these steps are included in the following sections.

For more information about installation and configuration of SAP ERP and SAP Solution Manager servers, see the [Deploying SAP in Oracle and Linux Environments Using the Hitachi Adaptable Modular Storage 2000 Family Installation and Configuration Guide](#) white paper.

SAP Deployment Considerations

Deploy the SAP ERP off-host server following the same guidelines the SAP ERP server. Depending on the workload required by the SAP ERP off-host server, users can either use high-end servers that provide availability, scalability and performance or any other supported server that could provide requisite processing needs on the off-host. However, use of highly available and scalable storage systems is a necessity for implementing SAP replication. As shown in Figure 2, accepted best practice is to deploy SAP Solution Manager, SAP ERP software on separate servers. Figure 2 shows multiple I/O paths providing high-availability and high I/O performance from the hosts to storage via a Fibre Channel director.

Server, Storage and Operating Environment Considerations

When deploying this solution, Hitachi Data Systems used the same hardware, software and storage configuration for SAP Solution Manager, SAP ERP server as described in the [Deploying SAP in Oracle and Linux Environments Using the Hitachi Adaptable Modular Storage 2000 Family Installation and Configuration Guide](#) white paper.

This solution assumes that the operating system and all the requisite software on SAP Solution Manager Server, SAP ERP server and SAP ERP off-host servers are installed. This white paper does not include details steps to install software. Table 3 lists storage configuration information for the SAP Solution Manager server, SAP ERP server and SAP ERP off-host server used for this solution.

Table 3. Tested Deployment Storage Configuration

RAID Group	RAID Level	Configuration	Usage
0	1+0	2+2	Differential management logical unit (DMLU), command devices.
4	1+0	2+2	Oracle data files and Oracle control files for SAP Solution Manager server.
5	1+0	2+2	Oracle binaries and Oracle logs for SAP Solution Manager server.
6	1+0	2+2	Central repository for SAP Solution Manager, SAP binaries for SAP Solution Manager server.
7	1+0	2+2	Central repository for SAP ERP server, SAP binaries for SAP ERP server.
8	1+0	2+2	Oracle binaries and Oracle logs for SAP ERP server. Logical units (LUs) for Oracle logs are P-VOLs for the replication process.
9	1+0	2+2	Oracle data files and Oracle control files for SAP Solution ERP server. LUs Oracle data files and Oracle Control files are P-VOLs for the replication process.
11	1+0	2+2	Central repository for SAP ERP on the off-host server, SAP binaries for SAP ERP on the off-host server.
12	1+0	2+2	Oracle Binaries and Oracle logs for SAP ERP on the off-host server. LUs for Oracle logs are S-VOLs for the replication process.
13	1+0	2+2	Oracle data files and Oracle control files for SAP Solution ERP on the off-host server. LUs Oracle data files and Oracle Control files are S-VOLs for the replication process.

The SAP ERP off-host server has same configuration (from server, storage, operating system and software perspectives) as the SAP ERP server, with one possible difference: Depending on the type of off-host processing, it is important to determine if the same system identifier (SID) for SAP ERP and Oracle is required on the off-host server or if different SIDs for SAP and Oracle are required. For off-host processing such as backup of production SAP system from an off-host server it might be necessary to have same SID as the SAP system, but for off-host processing such as testing, training, reporting and so on, a SID that is different from the production SAP system might be required.

This solution requires that the user number (UID) and the group number (GID) for the SAP software owner and Oracle users are the same on the SAP ERP server and the SAP ERP off-host server. Although the underlying RAID configuration, RAID type and disk type for the storage remains the same for the off-host server, the file system mount points might change based on the SID. Table 4 lists storage configuration details for SAP ERP off-host server.

Table 4. SAP ERP Off-host Server Storage Configuration

RAID Group	LUN	Size (GB)	File System Mount Point	Usage
11	231	20	/sapmnt	Central repository for SAP ERP off-host server
11	232	60	/usr/SAP/<SID>	File system to store SAP binaries
11	233	80	/usr/SAP/trans	Central location for moving data to another system when required
12	234	20	/oracle and /oracle/client	File system for ORACLE_BASE and Oracle client
12	235	40	/oraclestage and /oracle/<SID>	File system for Oracle binaries for installation of Oracle and home directory for Oracle user respectively
12	236	60	/sapreorg and /oracle/<SID>/<REL>	File system to temporarily store data for online data reorganization and location for ORACLE_HOME respectively
12	237	15	/oracle/<SID>/origlogA and /oracle/<SID>/mirrlogB	File system for online redo logs and duplex logs of the database
12	238	15	/oracle/<SID>/origlogB and /oracle/<SID>/mirrlogA	File system for online redo logs and duplex logs of the database
12	239	80	/oracle/<SID>/saparch	File system for archived redo logs
13	240	50	/oracle/<SID>/sapdata1	File system for SAP data
13	241	50	/oracle/<SID>/sapdata2	File system for SAP data
13	242	50	/oracle/<SID>/sapdata3	File system for SAP data
13	243	50	/oracle/<SID>/sapdata4	File system for SAP data

Configuring ShadowImage for Off-host Processing

Configure ShadowImage to replicate latest data from the SAP ERP server to the SAP ERP off-host server. Configuring of ShadowImage for this solution involves following high-level steps:

1. Configure DMLUs and command devices,
2. Configure ShadowImage In-System Replication using CCI between SAP ERP and SAP ERP off-host server.
3. Implement off-host processing for SAP ERP server using same SID as the production SAP ERP server or using a different SID than the production SAP ERP server.

Differential Management Logical Unit

A DMLU is an exclusive volume used for storing differential data at the time when the volume is copied. It also stores ShadowImage information when the storage system is powered down. Configure DMLUs before using ShadowImage software. The DMLU is like other volumes in the Hitachi Adaptable Modular Storage 2000 family storage system, but is hidden from the host as it stores internal structures required used only by the storage system. The minimum size for a DMLU is 10GB. Although only one DMLU is needed, Hitachi Data Systems recommends creation of two DMLUs for redundancy.

Use RAID-1+0 (2D + 2D) for the DMLUs and 146GB 15K SAS disks. DMLU performance depends on the amount of data that is changed in P-VOL and S-VOL.

Creating a DMLU

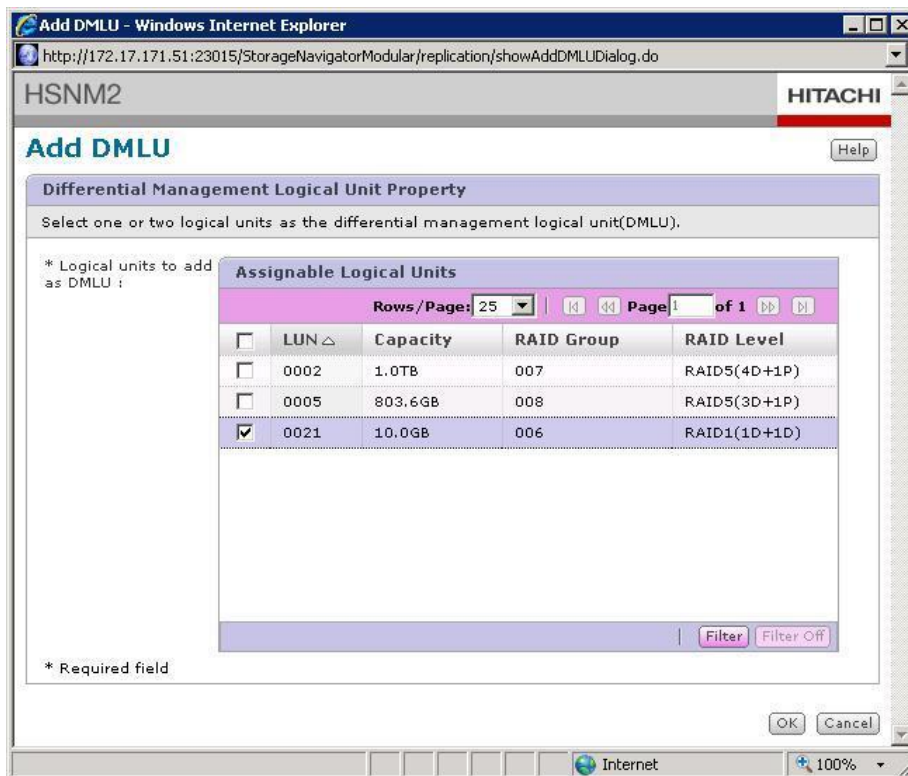
Follow these steps to create a DMLU:

1. Using Storage Navigator Modular 2 software, create a 10GB LU.
2. In the navigation tree, select **Settings**, then **DMLU**.

The Differential Management Logical Units screen displays.

3. Click the **Add DMLU** button.

The Add DMLU window displays.



4. Select the LUs that you want to assign as DMLUs and click **OK**.

A confirmation message displays.

5. Select the **Yes, I have read ...** check box, and click **Confirm**.
6. When the success message displays, click **Close**.

Command Devices

For this solution, a command device must be configured on the 2000 family storage system. A command device is a dedicated LU that is used by management software, such as Hitachi Command Control Interface (CCI), to interface with the storage system. The minimum size of a command device is 50MB. A command device must be assigned to all the hosts that are part of replication or wherever CCI is installed. Although only one command device is needed, Hitachi Data Systems recommends creation of two command devices for redundancy. Use RAID-1+0 (2D + 2D) for the command device LUs and 146GB 15K SAS disks.

Creating a Command Device

Follow these steps to create a command device in Storage Navigator:

1. Create an LU.

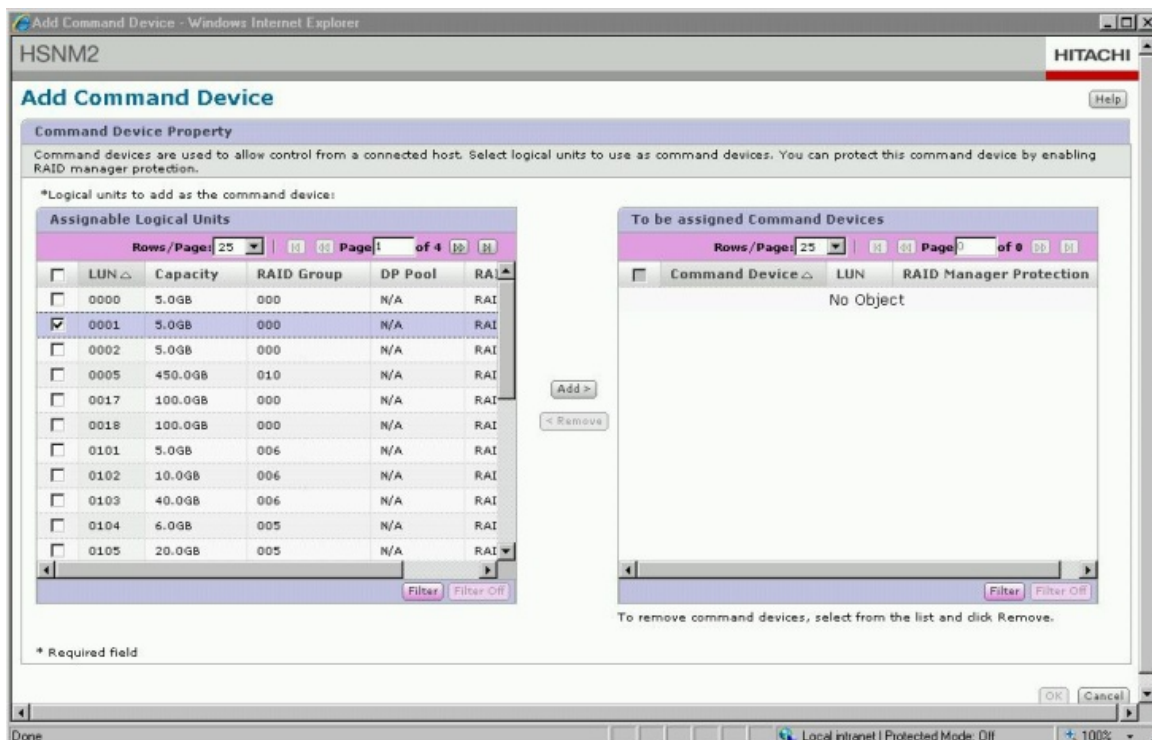
This solution uses 5GB LUs.

2. Present the LU to the host group that has connectivity to the server.
3. In the navigation tree, click **Settings**, then **Command Devices**.

The Command Devices window opens.

4. Click the **Add Command Device** button.

The Add Command Device window opens.



5. Click the created LU and click **Add** to add it to the command device list.
6. Click **OK**.

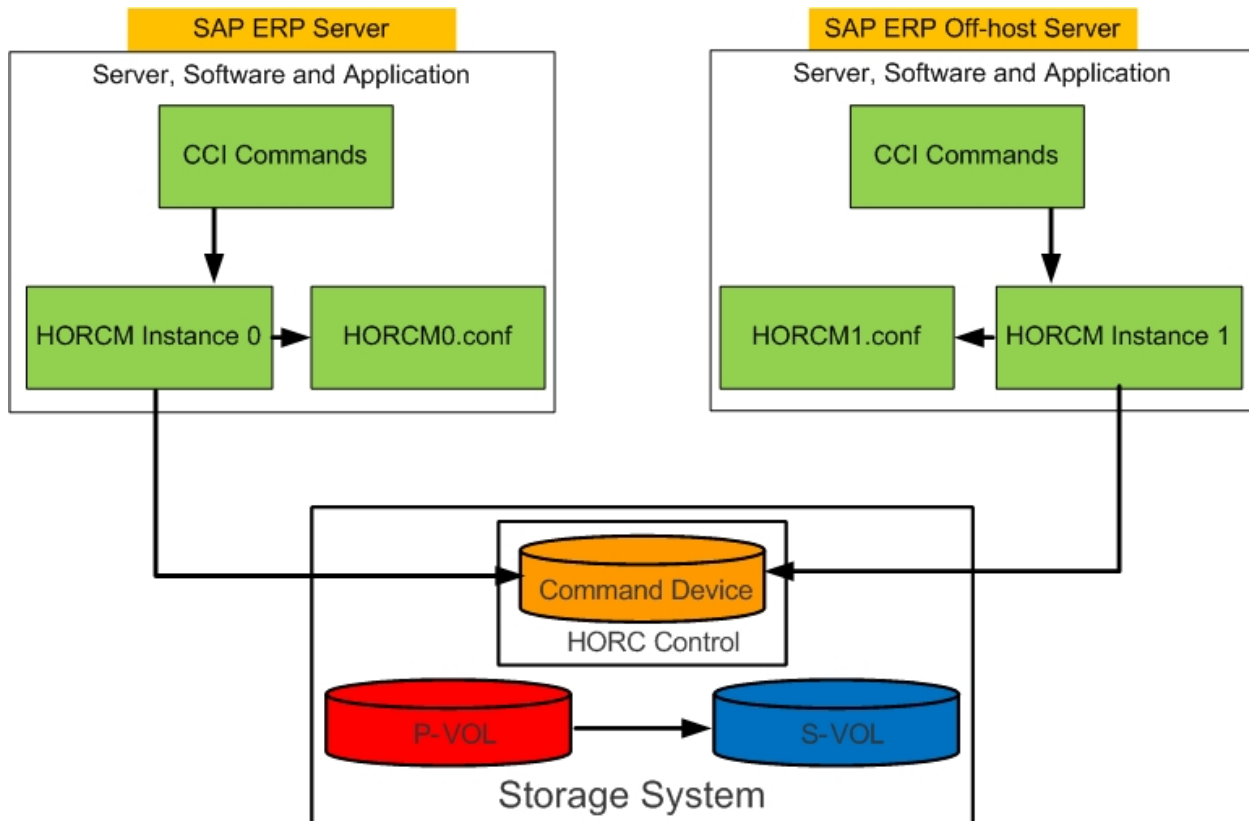
After the command device is created, make it visible to the SAP ERP server and the SAP ERP off-host server by adding them to appropriate host groups so that CCI can use it to configure ShadowImage in-system replication between them.

Configure Replication using CCI

CCI has two components, one residing on the storage system and another residing on the server. The CCI components residing on the storage system are command devices and ShadowImage volumes (PVOLs, SVOLs). The components residing on the servers are Hitachi Open Remote Copy Manager also known as HORCM, configuration definition files (for example, horcm1.conf) and CCI commands. Although the ShadowImage software residing in the 2000 family maintains the replication of data between the P-VOLs and the S-VOLs, it is the CCI software that allows the users to manage, monitor and control the ShadowImage process.

The HORCM operational environment operates as a daemon process on the host server. When HORCM is activated it refers to the configuration definition files. The HORCM instance communicates with the storage sub-system and remote servers. Two HORCM instances are required for a ShadowImage to be operational; one manages the P-VOLs, while the other HORCM instance manages the S-VOLs. The HORCM configuration file defines the communication path and the logical units (LUs) to be controlled. Each HORCM instance has its own HORCM configuration file. The horcm0.conf and the horcm1.conf files used for this solution are available in Appendix B. Also, modify the /etc/services file to register the port name and number for each HORCM instance on each server. The entries for HORCM in the /etc/services file must be the same on all the servers. For example, for port name horcm0 the service number might be 11000/udp in the /etc/services file on all the servers. Figure 3 shows a two-server, two-HORCM instance configuration used for CCI for this solution.

Figure 3. Hitachi ShadowImage In-System Replication using CCI



For more information about setting up the HORCM instances and HORCM configuration file, see the *Hitachi Tagmastore Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) Users and Reference Guide* that accompanies the Hitachi Command Control Interface software.

The CCI commands are generally executed as root user. However, CCI can be configured to allow users other than root user to execute the command to manager replication. For this solution the CCI commands are executed by user other than the root user. For more information about how to configure CCI to allow users other than root to manage replication using CCI, see Appendix C.

In Hitachi Adaptable Modular Storage 2000 family, the ShadowImage software consistency group function allows a user-defined group of ShadowImage volume pairs to be split simultaneously with a single command. This copy method creates a data-consistent point-in-time copy of an entire system, database or any related sets of volumes. Multiple ShadowImage pairs can be defined as one consistency group using CCI.

After the HORCM instance is started on all the servers, CCI commands can be executed to manage, monitor, and control replication between the servers. Table 5 lists CCI commands for PAIR operations.

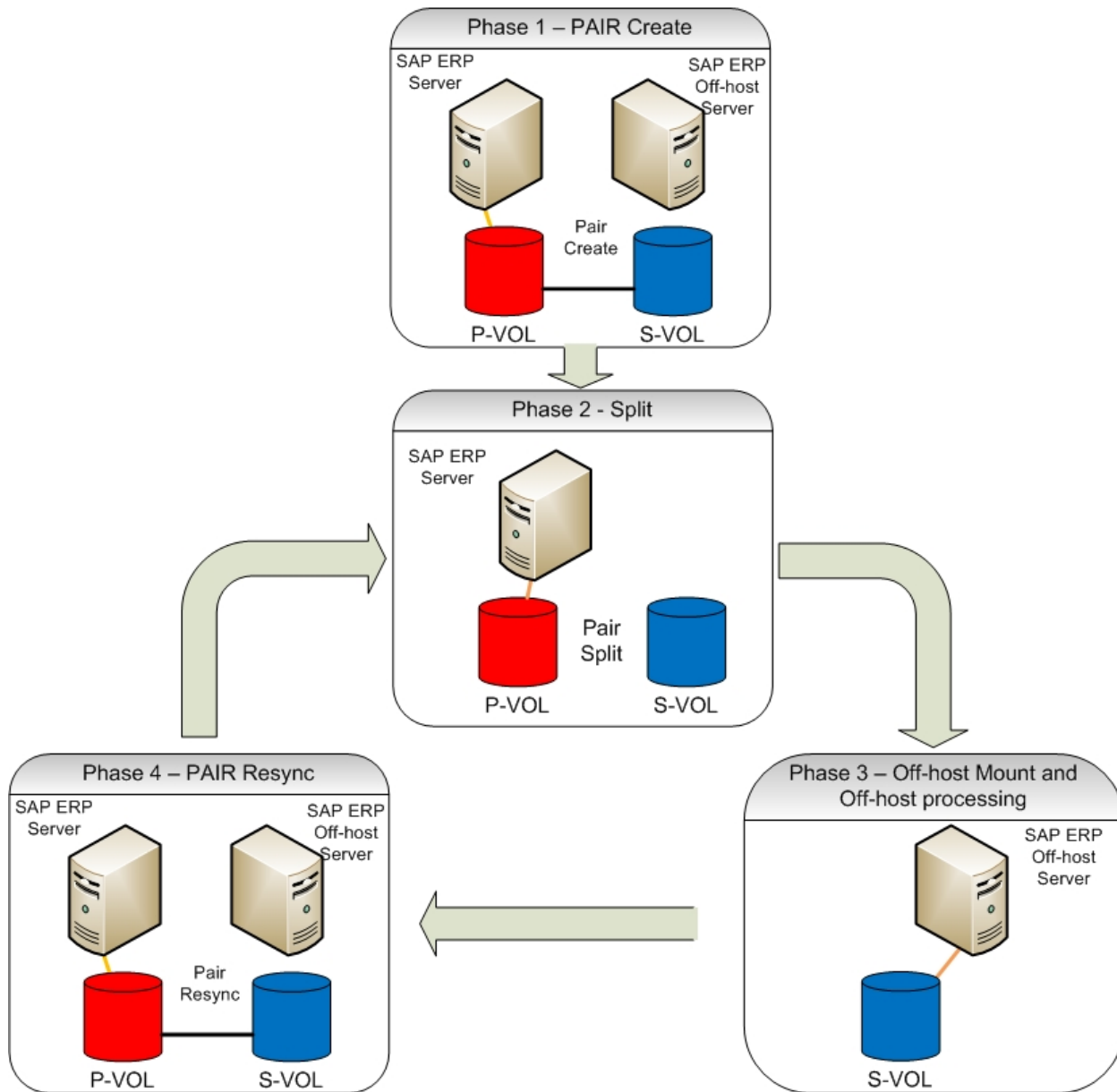
Table 5. CCI Commands for PAIR Operation

<i>Command Name</i>	<i>Description</i>	<i>Notes</i>
<code>paircreate</code>	Creates a new pair.	Status of P-VOL and S-VOL changes from SMPL to PAIR.
<code>pairsplit</code>	Splits pairs and create a point-in-time backup in the S-VOL by stopping the update of the secondary volume. The pair relationship of the P-VOL is maintained, and the differential information is also maintained.	Status of P-VOL changes from PAIR or COPY to PSUS. Status of S-VOL changes from PAIR or COPY to SSUS.
<code>pairsync</code>	Resynchronizes pairs from PSUS or SSUS status. The direction of resynchronization is from P-VOL to S-VOL. Uses differential information to resynchronize. Only changed data needs to be copied.	Status of P-VOL changes from PSUS to PAIR. Status of S-VOL changes from SSUS to PAIR.
<code>pairsync – restore</code>	Resynchronizes pairs from PSUS or SSUS status. The direction of resynchronization is from S-VOL to P-VOL. Uses differential information to resynchronize. Only changed data needs to be copied.	Status of P-VOL changes from PSUS to PAIR. Status of S-VOL changes from SSUS to PAIR.
<code>pairsplit –S</code>	Discards the pair’s differential information and deletes the pair.	Status of P-VOL changes to SMPL.
<code>pairwait</code>	Command to wait until a group enters a specified status. This command is needed to make a positive transition to the PAIR status.	N/A.
<code>pairdisplay</code>	Checks pair status and progress rate	N/A.

Off-host Processing of SAP ERP System

For uninterrupted execution of the SAP system in the production environment, you must move production-like processes, CPU and I/O to a different server. To achieve this, make a consistent point-in-time copy of production server application data available on a different server using ShadowImage and BRBackup. This copy of data can be used for off-host processing for functions like quality assurance testing, training, development, reporting, off-host backup and more. Figure 4 illustrates how the off-host processing can be achieved repeatedly using BRBackup and ShadowImage.

Figure 4. Off-host Processing of SAP ERP System



This solution tightly couples ShadowImage and BRBackup. The flexibility of BRBackup allows users to initiate the backup process either from the production server or the off-host server using the `brbackup` command and a configuration file. BRBackup allows users to perform an on-line split of the mirrored volumes. The ShadowImage `pair split` and `pair resync` commands can be embedded within the BRBackup configuration file. See Appendix A and Appendix B for the BRBackup configuration files.

Although BRBackup can be initiated from either the production server or from the off-host server, the solution described in this white paper initiates BRBackup from the off-host server. When initiating BRBackup from the off-host server, include an entry in the Oracle networking file `tnsnames.ora` on the off-host server allowing a database connection from the off-host server to the production server.

Note that when initiating BRBackup from the production server, you must include a step to move or remove the control file created by the BRBackup process on the production server.

When BRBackup process is initiated to perform a backup, it goes through a variety of steps such as creating a copy of control file, copying the control file on the off-host, checking a variety of database files, placing database in backup mode, executing the `pairsplit` command, taking the database out of backup mode and overwriting old control files. Note that this solution does not use all of BRBackup's processes and as a result, you might see warnings or error messages in the BRBackup log file. However, the key steps like transitioning the database in the backup mode, executing the `pairsplit` command and taking the database out of backup mode are successful. Hitachi Data Systems recommends ignoring most warning or error messages in the BRBackup log files; instead review only successful `Alter database begin backup`, `successful Split of mirror disks successful` and `successful Alter database end backup successful` messages.

Your use of secondary data determines whether you use the same SID or a different SID. The following sections provide information about both replication methods.

Because the solution described in this white paper installs and configures SAP ERP on the off-host server, it creates ShadowImage pairs of the volumes containing database data. Database data includes data files, log files and control files.

Replicating the SAP System with the Same SID

The SAP ERP system deployment consists of SAP and Oracle binary files (SAP and Oracle) and database data. SAP ERP binary files and Oracle binary files are deployed LUs that are separate from LUs containing database data.

Follow these steps to replication an SAP system using the same SID:

1. Stop SAP and the Oracle database by executing the following command as SAP user on the off-host server:

```
# stopsap
```

2. Stop the Oracle listener by executing the following command as Oracle user on the off-host server:

```
# lsnrctl stop
```

3. Unmount the file systems containing database data, logs and control files of the off-host server.
4. Create a ShadowImage pairs in consistency groups between LUs of database data of the SAP ERP server (P-VOLs) and the corresponding LUs of database data of the SAP ERP off-host serves (S-VOLs) by executing the following command on the production server:

```
# paircreate -g SAP-G01 -vl -m grp -IM0
```

Monitor the pair create process either by executing the `pairdisplay -g SAP-G01 -fc` command until the P-VOLs and S-VOLs are in PAIR status.

5. Initiate BRBackup to create a consistent point-in-time split image of the SAP ERP system by executing the following command as Oracle user from the off-host server:

```
# brbackup -u system -t online_split -p inittPRD.sap.onsplit
```

BRBackup places database in backup mode, splits the P-VOLs and S-VOLs using the ShadowImage `pairsplit` command and takes the database out of backup mode.

6. Mount the file system containing database data on the off-host server.

7. Start the Oracle database in the mount state by executing the following command on the off-host server:

```
SQLPLUS> startup mount;
```

8. Recover the database by executing the following command on the off-host server:

```
SQLPLUS> recover database;
```

9. Open the database by executing the following command on the off-host server:

```
SQLPLUS> alter database open;
```

10. Shut down the database by executing the following command on the off-host server:

```
SQLPLUS> shutdown;
```

11. Start Oracle listener by executing the following command as Oracle user on the off-host server.

```
# lsnrctl start
```

12. Start SAP and Oracle database by issuing the following command as SAP user on the off-host server:

```
# startsap
```

The SAP ERP system on the off-host is now available for off-host processing with same SID and with the latest data from the production SAP ERP system.

Note: When you need to refresh the data from the SAP ERP system, the LUs (S-VOLs) of the SAP ERP system on off-host server can be resynchronized with the data from P-VOL. This process uses the same steps listed in this procedure, except the command executed in Step 4 changes as follows:

```
# pari resync -g SAP-G01 -IM0
```

Replicating the SAP System with a Different SID

The SAP ERP system deployment consists of SAP and Oracle binary files and database data. SAP ERP binary files and Oracle binary files are deployed LUs that are separate from LUs containing database data.

The user name of the SAP ERP software owner and the Oracle software owner depend on the SID of the SAP ERP system. The fact that the SID is different on the SAP ERP off-host server implies that SAP ERP software owner and Oracle software user names are different than the production server. The UID and group identification numbers (GID) must be the same.

Follow these steps to replicate the SAP system with a different SID:

1. Stop SAP and Oracle database by executing the following command as SAP user on the off-host server:

```
# stopsap
```

2. Stop Oracle listener by executing the following command as Oracle user on the off-host server:

```
# lsnrctl stop
```

3. Unmount the file systems containing database data on the off-host sever.

4. Create consistent ShadowImage pairs between the LUs for the database data of the SAP ERP server (P-VOLs) and the corresponding LUs for database data of the SAP ERP off-host servers (S-VOLs) by executing the following command on the production server:

```
# paircreate -g SAP-G01 -vl -m grp -IM0
```

Monitor the pair create process either by executing the `pairdisplay -g SAP-G01 -fc` command until the P-VOLs and S-VOLs are in PAIR status.

5. As Oracle user, create an Oracle text-based server parameter file (pfile) on the production server from the binary server parameter (spfile) copy it to the off-host server by executing the following command:

```
SQLPLUS> create pfile from spfile ;
```

6. Initiate BRBackup to create a consistent point-in-time split image of the SAP ERP system by executing the following command on the off-host server:

```
# brbackup -u system -t online_split -p iniprd.sap.onsplit
```

BRBackup places database in backup mode, instructs ShadowImage software to split the P-VOLs and S-VOLs and takes the database out of backup mode.

Ensure that the value of environment variables SAPBACKUP, SAPDATA_HOME and ORACLE_SID on the SAP ERP off-host server match those environment variables on the SAP ERP server.

7. On the off-host server, mount the file system containing database data.

The mount points for these files match the production host.

8. On the off-host server, review the pfile created and copied in Step 5 to ensure that the dump destination parameters have correct locations to reflect to the new server and mount points.
9. Start the Oracle database in mount state using the pfile modified in Step 8 by executing the following command on the off-host server:

```
# export ORACLE_SID=PRD
```

```
SQLPLUS> startup mount pfile=iniprd.ora;
```

The database name and database SID match the production server.

10. Recover the database by executing the following command on the off-host server:

```
SQLPLUS> recover database;
```

11. Open the database by executing the following command on the off-host server:

```
SQLPLUS> alter database open;
```

12. Shut down the database by executing the following command on the off-host server:

```
SQLPLUS> shutdown;
```

13. Start the Oracle database in mount state using the pfile by executing the following command on the off-host server:

```
# export ORACLE_SID=PRD
```

```
SQLPLUS> startup mount pfile=iniprd.ora;
```

14. Rename the Oracle database and Oracle database ID (DBID) using the NID tool by issuing the following command on the off-host server:

```
# nid TARGET=<userid>/<password> DBNAME=DEV
```

15. Create a valid pfile for the renamed database (DEV).

An easy way to accomplish this is to copy `initPRD.ora` to `initDEV.ora` and change the parameter `db_name` in `initDEV.ora`.

16. Start the new Oracle database in mount state using the pfile modified in Step 15 by executing the following command on the off-host server:

```
# export ORACLE_SID=DEV
SQLPLUS> startup mount pfile=initDEV.ora;
```

17. Open the database using the RESETLOGS option by executing the following command on the off-host server:

```
SQLPLUS> alter database open RESETLOGS;
```

18. Reset the password or SAPSR3 user in the database by executing the following command on the off-host server:

```
SQLPLUS> alter user SAPSR3 identified by sap;
```

19. Create a binary spfile from the text based pfile by executing the following command on the off-host server:

```
SQLPLUS> create spfile from pfile=initDEV.ora ;
```

20. Shut down the database by executing the following command on the off-host server:

```
SQLPLUS> Shutdown;
```

21. Start Oracle listener by executing the following command as Oracle user on the off-host server:

```
# lsnrctl start
```

22. Start SAP and the Oracle database by executing the following command as SAP user on the off-host server:

```
# startsap
```

The SAP ERP system on the off-host are now available for off-host processing with a different SID than the production SAP ERP system and with the latest data from the production SAP ERP system.

Note: When you need to refresh the data from the SAP ERP system, the LUs (S-VOLs) of the SAP ERP system on off-host server can be resynchronized with the data from PVOL. This process uses the same steps listed in this procedure, except the command executed in Step 4 changes as follows:

```
# pari resync -g SAP-G01 -IM0
```

This allows the SAP ERP system off-host server to obtain data from the SAP ERP system on the production server. These steps can be scripted to make off-host processing into a repeatable process.

Appendix A: Configuration, Parameter and Script Files for Tested Deployment for Replicating SAP System Using the Same SIDs

Hitachi Data Systems used the following files for replicating an SAP system using the same SID:

- BRBackup configuration file
- Script file for splitting P-VOLs and S-VOLs
- Oracle server parameter file on the SAP ERP server
- Oracle server parameter file on the SAP ERP off-host server

BRBackup Configuration File

#FileName: ini tPRD. sap. onspl i t

```
backup_mode = full
restore_mode = full
backup_dev_type = disk
backup_type = online_split
split_cmd = "/oracl e/PRD/102_64/dbs/do_onspl i t. sh"
primary_db = PRD
orig_db_home = /oracl e/PRD
remote_host = r905-06
remote_user = oraprd
stage_copy_cmd = scp
backup_root_dir = /oracl e/PRD/sapbackup
```

Script File for Splitting P-VOLs and S-VOLs

#FileName: do_onspl i t. sh

```
export HOCMINST=1
export HORCC_MRCF=1
export HORCC_LOG=/home/oraprd
```

```
pairspl i t -g SAP-G01
```

Oracle Server Parameter File on the SAP ERP Server

#FileName: ini tPRD. ora

```
*. _B_TREE_BITMAPPLANS=FALSE
```

```

*. _I N_MEMORY_UNDO=FALSE
*. _I NDEX_JO I N_ENABLED=FALSE
*. _OPTI M_PEEK_USER_BI NDS=FALSE
*. _OPTI MI ZER_MJC_ENABLED=FALSE
*. _SORT_EL I MI NATI ON_COST_RATI O=10
*. _TABLE_LOOKUP_PREFETCH_SI ZE=0
*. background_dump_dest='/oracl e/PRD/saptrace/background'
*. compati bl e=' 10. 2. 0'
*. control _fi l e_record_keep_ti me=30
*. control _fi l es=' /oracl e/PRD/ori gl ogA/cntrl /cntrl PRD. dbf' , ' /oracl e/PRD/ori gl o
gB/cntrl /cntrl PRD. dbf' , ' /oracl e/PRD/sapdata1/cntrl /cntrl PRD. dbf'
*. core_dump_dest='/oracl e/PRD/saptrace/background'
*. db_bl ock_si ze=8192
*. db_cache_si ze=9133306675
*. db_fi l es=254
*. db_name=' PRD'
*. dml _l ocks=4000
*. event=' 10191 trace name context forever, l evel 1'
*. FI LESYSTEMI O_OPTI ONS=' setal l '
*. j ob_queue_processes=1
*. l og_archi ve_dest='/oracl e/PRD/saparch/PRDarch'
*. l og_buffer=1048576
*. l og_checkpoi nt_i nterval =0
*. l og_checkpoi nts_to_al ert=true
*. open_cursors=800
*. paral l el _executi on_message_si ze=16384
*. pga_aggregate_target=12177742233
*. processes=80
*. query_rewri te_enabl ed=' fal se'
*. recycl ebi n=' off'
*. remote_l ogi n_passwordfi l e=' excl usi ve'
*. remote_os_authent=true
*. repl i cati on_dependency_tracki ng=fal se
*. sessi ons=96
*. sga_max_si ze=18266613350

```

```

*. shared_pool_reserved_size=913330667
*. shared_pool_size=9133306675
*. sort_area_reserved_size=0
*. sort_area_size=2097152
*. star_transformation_enabled=' true'
*. undo_management=' AUTO'
*. undo_retention=43200
*. undo_tablespace=' PSAPUNDO'
*. user_dump_dest=' /oracle/PRD/saptrace/usertrace'

```

Oracle Server Parameter File on the SAP ERP Off-host Server

#FileName: initsap.ora

```

*. _B_TREE_BITMAP_PLANS=FALSE
*. _IN_MEMORY_UNDO=FALSE
*. _INDEX_JOIN_ENABLED=FALSE
*. _OPTIM_PEEK_USER_BINDS=FALSE
*. _OPTIMIZER_MJC_ENABLED=FALSE
*. _SORT_ELIMINATION_COST_RATIO=10
*. _TABLE_LOOKUP_PREFETCH_SIZE=0
*. background_dump_dest=' /oracle/PRD/saptrace/background'
*. compatible=' 10.2.0'
*. control_file_record_keep_time=30
*. control_files=' /oracle/PRD/origlogA/cntrl/cntrlPRD.dbf', '/oracle/PRD/origlogB/cntrl/cntrlPRD.dbf', '/oracle/PRD/sapdata1/cntrl/cntrlPRD.dbf'
*. core_dump_dest=' /oracle/PRD/saptrace/background'
*. db_block_size=8192
*. db_cache_size=9133306675
*. db_files=254
*. db_name=' PRD'
*. dml_locks=4000
*. event=' 10191 trace name context forever, level 1'
*. FILESYSTEMIO_OPTIONS=' setall'
*. job_queue_processes=1
*. log_archive_dest=' /oracle/PRD/saparch/PRDarch'
*. log_buffer=1048576

```

- *. log_checkpoint_interval=0
- *. log_checkpoint_to_alert=true
- *. open_cursors=800
- *. parallel_execution_message_size=16384
- *. pga_aggregate_target=12177742233
- *. processes=80
- *. query_rewrite_enabled='false'
- *. recyclebin='off'
- *. remote_login_passwordfile='exclusive'
- *. remote_os_authent=true
- *. replication_dependency_tracking='false'
- *. sessions=96
- *. sga_max_size=18266613350
- *. shared_pool_reserved_size=913330667
- *. shared_pool_size=9133306675
- *. sort_area_retained_size=0
- *. sort_area_size=2097152
- *. star_transformation_enabled='true'
- *. undo_management='AUTO'
- *. undo_retention=43200
- *. undo_tablespace='PSAPUNDO'
- *. user_dump_dest='/oracle/PRD/saptrace/usertrace'

Appendix B: Configuration, Parameter and Script Files For Tested Deployment for Replicating SAP Systems Using Different SIDs

Hitachi Data Systems used the following files for replicating an SAP System using different SID:

- BRBackup configuration file
- Script file for splitting P-VOLs and S-VOLs
- Oracle server parameter file on the SAP ERP server
- Oracle server parameter file on the SAP ERP off-host server

BRBackup Configuration File

#FileName: ini tDEV. sap. onspl i t

```
backup_mode = full
restore_mode = full
backup_dev_type = disk
backup_type = online_split
split_cmd = "/oracl e/DEV/102_64/dbs/do_onspl i t. sh"
primary_db = PRD
orig_db_home = /oracl e/PRD
remote_host = r905-06
remote_user = oraprd
stage_copy_cmd = scp
backup_root_dir = /oracl e/DEV/sapbackup
```

Script File for Splitting P-VOLs and S-VOLs

#FileName: do_onspl i t. sh

```
export HOCMINST=1
export HORCC_MRCF=1
export HORCC_LOG=/home/oradev
```

```
pairspl i t -g SAP-G01
```

Oracle Server Parameter File on the SAP ERP Server

#FileName: ini tPRD. ora

```
*. _B_TREE_BITMAPMAP_PLANS=FALSE
```

```

*. _I N_MEMORY_UNDO=FALSE
*. _I NDEX_JO I N_ENABLED=FALSE
*. _OPTI M_PEEK_USER_BI NDS=FALSE
*. _OPTI MI ZER_MJC_ENABLED=FALSE
*. _SORT_EL I MI NATI ON_COST_RATI O=10
*. _TABLE_LOOKUP_PREFETCH_SI ZE=0
*. background_dump_dest='/oracl e/DEV/saptrace/background'
*. compati bl e=' 10. 2. 0'
*. control _fi l e_record_keep_ti me=30
*. control _fi l es=' /oracl e/PRD/ori gl ogA/cntrl /cntrl PRD. dbf' , ' /oracl e/PRD/ori gl o
gB/cntrl /cntrl PRD. dbf' , ' /oracl e/PRD/sapdata1/cntrl /cntrl PRD. dbf'
*. core_dump_dest=' /oracl e/DEV/saptrace/background'
*. db_bl ock_si ze=8192
*. db_cache_si ze=9133306675
*. db_fi l es=254
*. db_name=' PRD'
*. dml _l ocks=4000
*. event=' 10191 trace name context forever, l evel 1'
*. FI LESYSTEMI O_OPTI ONS=' setal l '
*. j ob_queue_processes=1
*. l og_archi ve_dest=' /oracl e/PRD/saparch/PRDarch'
*. l og_buffer=1048576
*. l og_checkpoi nt_i nterval =0
*. l og_checkpoi nts_to_al ert=true
*. open_cursors=800
*. paral l el _executi on_message_si ze=16384
*. pga_aggregate_target=12177742233
*. processes=80
*. query_rewri te_enabl ed=' fal se'
*. recycl ebi n=' off'
*. remote_l ogi n_passwordfi l e=' excl usi ve'
*. remote_os_authent=true
*. repl i cati on_dependency_tracki ng=fal se
*. sessi ons=96
*. sga_max_si ze=18266613350

```

```

*. shared_pool_reserved_size=913330667
*. shared_pool_size=9133306675
*. sort_area_reserved_size=0
*. sort_area_size=2097152
*. star_transformation_enabled=' true'
*. undo_management=' AUTO'
*. undo_retention=43200
*. undo_tablespace=' PSAPUNDO'
*. user_dump_dest='/oracle/DEV/saptrace/usertrace'

```

Oracle Server Parameter File on the SAP ERP Off-host Server

#FileName: initDEV.ora

```

*. _B_TREE_BITMAP_PLANS=FALSE
*. _IN_MEMORY_UNDO=FALSE
*. _INDEX_JOIN_ENABLED=FALSE
*. _OPTIM_PEEK_USER_BINDS=FALSE
*. _OPTIMIZER_MJC_ENABLED=FALSE
*. _SORT_ELIMINATION_COST_RATIO=10
*. _TABLE_LOOKUP_PREFETCH_SIZE=0
*. background_dump_dest='/oracle/DEV/saptrace/background'
*. compatible=' 10. 2. 0'
*. control_file_record_keep_time=30
*. control_files='/oracle/PRD/origlogA/cntrl/cntrl PRD. dbf', '/oracle/PRD/origlogB/cntrl/cntrl PRD. dbf', '/oracle/PRD/sapdata1/cntrl/cntrl PRD. dbf'
*. core_dump_dest='/oracle/PRD/saptrace/background'
*. db_block_size=8192
*. db_cache_size=9133306675
*. db_files=254
*. db_name=' DEV'
*. dml_locks=4000
*. event=' 10191 trace name context forever, level 1'
*. FILESYSTEMI0_OPTIONS=' setall '
*. job_queue_processes=1
*. log_archive_dest='/oracle/PRD/saparch/PRDarch'
*. log_buffer=1048576

```

- *. log_checkpoint_interval=0
- *. log_checkpoint_to_alert=true
- *. open_cursors=800
- *. parallel_execution_message_size=16384
- *. pga_aggregate_target=12177742233
- *. processes=80
- *. query_rewrite_enabled='false'
- *. recyclebin='off'
- *. remote_login_passwordfile='exclusive'
- *. remote_os_authent=true
- *. replication_dependency_tracking='false'
- *. sessions=96
- *. sga_max_size=18266613350
- *. shared_pool_reserved_size=913330667
- *. shared_pool_size=9133306675
- *. sort_area_retained_size=0
- *. sort_area_size=2097152
- *. star_transformation_enabled='true'
- *. undo_management='AUTO'
- *. undo_retention=43200
- *. undo_tablespace='PSAPUNDO'
- *. user_dump_dest='/oracle/DEV/saptrace/usertrace'

Appendix C: Changing CCI User from root

The CCI software is initially configured to allow only the root user (system administrator) to execute CCI commands. If desired (for example CCI administrator does not have root access), the system administrator can change the CCI user from root to another user name.

Follow these steps to change the CCI user from root to another user name:

1. Change the owner of the following CCI files from the root user to the desired user name:
 - /HORCM/etc/horcmgr
 - All CCI commands in the /HORCM/usr/bin directory
 - All CCI log directories in the /HORCM/Log* directories

2. Change the owner of the raw device file of the HORCM_CMD command in the configuration definition file from the root user to the desired user name.

Note that ownership must remain persistent across system reboots.

3. Configure the system to start the HORCM daemon during the system startup process.

Create a startup script and place it in the /etc/init.d directory and execute the HORCM startup script (horcmstart.sh) from the startup script. The startup script must set the environment variable HORCM_EVERYCLI=1 and change the owner of the /HORCM/.uds directory after the HORCM daemon starts.

4. When executing CCI commands, set the HORCC_LOG variable to appropriate value indicating the HORCM LOG location where the owner has permission to create a log file.

Appendix D: ShadowImage Configuration Files

ShadowImage configuration files consist of following sections:

- **HORCM_MON** — Contains information need to monitor a HORCM instance such as IP address, HORCM instance or service, pooling interval for monitoring paired volumes and timeout period for communication with remote server.
- **HORCM_CMD** — Contains device path information about the command device.
- **HORCM_DEV** — Defines the storage sub-system device address for the paired logical volume names.
- **HORCM_I NST** — Network address of the remote server.

ShadowImage Configuration Files for SAP ERP Server

#File Name: horcm0.conf

#!/***** For HORCM_MON *****/

HORCM_MON

#i p_address	servi ce pol I (10ms)	ti meout (10ms)
172. 17. 242. 56 horcm0	1000	3000

#!/***** For HORCM_CMD *****/

HORCM_CMD

#dev_name	dev_name	dev_name
/dev/sdb	/dev/sdc	

#!/***** For HORCM_DEV *****/

HORCM_DEV

#dev_group	dev_name	port#	TargetID	LU#	MU#
SAP-G01	SAP-DEV7	CL1-A	0	207	0
SAP-G01	SAP-DEV8	CL1-A	0	208	0
SAP-G01	SAP-DEV9	CL1-A	0	209	0
SAP-G01	SAP-DEV10	CL1-A	0	210	0
SAP-G01	SAP-DEV11	CL1-A	0	211	0
SAP-G01	SAP-DEV12	CL1-A	0	212	0
SAP-G01	SAP-DEV13	CL1-A	0	213	0

#!/***** For HORCM_I NST *****/

HORCM_I NST

#dev_group	i p_address	servi ce
SAP-G01	172. 17. 242. 57	horcm1

ShadowImage Configuration Files for SAP ERP Off-host Server

#FileName: horcm1.conf

#!/***** For HORCM_MON*****/

HORCM_MON

#ip_address		service	poll (10ms)	timeout (10ms)
172.17.242.57	horcm1	1000		3000

#!/***** For HORCM_CMD*****/

HORCM_CMD

#dev_name		dev_name	dev_name
/dev/sdb	/dev/sdc		

#!/***** For HORCM_DEV *****/

HORCM_DEV

#dev_group	dev_name	port#	TargetID	LU#	MU#
SAP-G01	SAP-DEV7	CL1-A	0	237	0
SAP-G01	SAP-DEV8	CL1-A	0	238	0
SAP-G01	SAP-DEV9	CL1-A	0	239	0
SAP-G01	SAP-DEV10	CL1-A	0	240	0
SAP-G01	SAP-DEV11	CL1-A	0	241	0
SAP-G01	SAP-DEV12	CL1-A	0	242	0
SAP-G01	SAP-DEV13	CL1-A	0	243	0

#!/***** For HORCM_INST *****/

HORCM_INST

#dev_group	ip_address	service
SAP-G01	172.17.242.56	horcm0



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